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DISCUSSION

Dr Timothy K. Liem (*Portland, Ore*). I would like to congratulate Dr Ham and the vascular group at University of Southern California (USC) for an excellent presentation and to thank them for sending me the manuscript in advance. Their experience represents one of the larger series of aortic debranching procedures, and their results have added confirmation to our notion that a hybrid approach for the repair of extensive aneurysmal disease is not without significant associated morbidity. In fact, the authors described a 40% morbidity, mostly due to pulmonary and renal complications, and to a lesser degree, procedural complications such as bleeding, graft occlusion, and endoleak reintervention.

We perform extensive debranching procedures as well, and results such as these have tempered our enthusiasm for the hybrid procedure as a panacea, which would completely replace open thoracoabdominal aneurysm repair. Depending on how many vessels require "debranching," many of you know that these procedures can be a tour de force, requiring many hours to complete, with multiple surgical teams.

The existing literature regarding hybrid procedures is for the most part, limited to single-institution series. The USC group has presented a largely observational study that mirrors that trend. They describe the clinical results in a diverse group of patients who underwent some form of debranching and stent graft placement for aneurysmal disease of the aortic arch, proximal descending thoracic aorta, thoracoabdominal aorta, or for para-anastomotic aneurysms. The term "hybrid procedure" includes a wide spectrum of surgeries, ranging from isolated subclavian transposition or carotid-carotid bypass, performed through small incisions, to extensive multivessel debranching, requiring sternotomy or large midline abdominal incisions.

This study is limited by a lack of comparison between groups. For example, it would have been interesting to compare open vs hybrid thoracoabdominal aneurysm repairs, or even single vessel vs multi-vessel debranching procedures, and this leads me to the first of several questions:

1. How many patients received a single-vessel debranching procedure vs four-vessel debranching? The manuscript did not specify the number and distribution of debranched vessels, but this information would be vital to allow comparison between differing series.
2. Forty percent of the patients had symptomatic aneurysms or para-anastomotic aneurysms. Yet, 75% of patients underwent staged procedures with a mean interval of 28 days between the debranching and the stent graft placement. Was the diagnosis of symptomatic aneurysm equivocal in some, or is our algorithm for the urgent treatment of symptomatic aneurysms changing?
3. Your manuscript describes a very respectable graft patency of 93.6% at 1 and 3 years. However, there were four graft occlusions in the postoperative period, involving three renal arteries and one carotid artery, with two revisions performed with no reported untoward sequelae. When were the graft thromboses discovered, and can you expand upon how the revisions were performed? Since the kidneys do not tolerate lengthy periods of ischemia, were these revisions performed emergently and how do you know that renal function was preserved?
4. What portion of your descending thoracic aneurysm and thoracoabdominal aortic aneurysm practice does this series represent, and what is your comparative mortality and morbidity with completely open thoracic and thoracoabdominal aneurysm repair?

Your manuscript cited a recent article from the University of Michigan group. They performed a retrospective comparison between total open vs hybrid repair of thoracoabdominal aneurysms, identifying that open repair correlated with a higher chance of combined mortality and morbidity? Can you give us insights into which group of patients would be most suitable for a hybrid approach versus total open repair?

I would like to thank the members of the program committee for giving me the privilege of discussing this paper.

Dr Sung Wan Ham. Only patients with arch or proximal descending thoracic aneurysm underwent a single vessel debranch. All patients with thoracoabdominal aneurysms underwent at least a two-vessel debranch with three-fourths requiring a three- to four-vessel debranch. Of the 27 patients with arch or descending thoracic aneurysm, including one para-anastomotic aneurysm, 16 underwent a single-vessel debranching procedure (9 left subclavian artery, 7 left common carotid bypass). In general, this cohort of patients did experience less morbidity, as all but one single-vessel debranching was performed without the need for sternotomy.

Symptomatic patients did not have rupture on computed tomography; however, they were debranched expeditiously and managed in the intensive care unit with intravenous control of hypertension, which was present in 90%. Their pain resolved in most cases. These patients subsequently underwent the endovascular stage during the same admission within an average of 8 days.

Of the four early graft occlusions, two underwent immediate revision ≤24 hours. One patient with preexisting ischemic nephropathy and a solitary kidney became anuric on postoperative 1 and was emergently taken to the operating room for revision of a thrombosed renal graft. It is likely that the patient had adequate collateralization from long-standing ischemic nephropathy, which prevented permanent ischemic injury. Her renal function improved and she was discharged with a functioning kidney. The other patient who underwent a right-to-left common carotid bypass and developed graft occlusion on postoperative day 5, before the endovascular repair. He was taken immediately for thrombectomy and subsequently underwent an uneventful endovascular repair of the arch aneurysm.

Our first hybrid procedure was performed to treat a patient with a type IV thoracoabdominal aneurysm in 2005. Since then, our techniques have evolved and we have extended the hybrid approach to treat aneurysms of the proximal descending thoracic aorta and the arch with relatively low mortality and paraplegia rates. Although we have not recently analyzed our results with open repair, historically our results have been what is reported in the literature, with a paraplegia rate of 5% to 10%, depending on the extent of the TAAA, with a composite incidence of paraplegia, renal failure, and early death of approximately 20%. Therefore, the hybrid approach has been our preferred method for treatment of thoracoabdominal aneurysms over the past 2 to 3 years, particularly in the older patient with atherosclerotic thoracoabdominal aneurysm.